

INTERNATIONAL  
ASSOCIATION FOR TESTING MATERIALS.

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AMERICAN SECTION.

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BULLETIN No. 17.

MAY, 1900.

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PROPOSED STANDARD SPECIFICATIONS

FOR

WROUGHT IRON.

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RECOMMENDED BY AMERICAN BRANCH OF COMMITTEE NO. 1, MAY 1, 1900.

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There will be a discussion of these specifications at the Third Annual Meeting of the American Section, to be held in New York, on October 25-27, 1900, and you are requested to send in your views by letter, or to be present and take part in the oral discussion.

After the Annual Meeting, Committee No. 1 will consider the points raised, and make any modifications that may be found necessary; and, if so decided at the Annual Meeting, the specifications will be sent to all members of the American Section for approval by letter ballot.

If the other countries perform their work in the same general manner, the final work of the introduction of International Specifications will be reduced to a very simple matter, as there will only be a limited number of specifications to consider instead of hundreds as at the present time.

WM. R. WEBSTER,

*Chairman of American Branch of Committee No. 1.*

## PROCESS OF MANUFACTURE.

1. Wrought iron shall be made by the puddling process or rolled from fagots or piles made up from No. 1 wrought iron scrap, alone or with muck bar added, it being understood that test iron Class B, and stay-bolt iron contain no scrap.

## PHYSICAL PROPERTIES.

2. The minimum physical qualities required in the four classes of wrought iron shall be as follows:

Tensile Test.	Refined iron.	Test iron Class A.	Test iron Class B.	Stay-bolt iron.
Tensile strength, pounds per sq. inch.....	48,000	48,000	50,000	46,000
Yield point, pounds per sq. inch.....	25,000	25,000	25,000	25,000
Elongation, per cent. in 8 inches.....	15	20	25	28

3. In sections weighing less than 0.654 pound per lineal foot the percentage of elongation required in the four classes specified in paragraph No. 2 shall be 11.25 per cent., 15.00 per cent., 18.75 per cent., and 21.00 per cent. respectively.

4. The four classes of iron when nicked and tested as described in paragraph No. 9 shall show the following fracture:

(a). Refined iron, a generally fibrous fracture, free from coarse crystalline spots. Not over 15 per cent. of the fractured surface shall be granular.

(b). Test iron Class A, a generally fibrous fracture, free from coarse crystalline spots. Not over 10 per cent. of the fractured surface shall be granular.

(c). Test iron Class B, a long, clean, silky fiber, free from slag or dirt or any coarse crystalline spots. A few fine crystalline spots may be tolerated provided they do not in the aggregate exceed 10 per cent. of the sectional area of the bar.

(a). Stay-bolt iron, a long, clean, silky fiber, free from slag or dirt, and wholly fibrous, being practically free from crystalline spots.



Specifications issued by	Date.	Name of materials.	Process of Manufacture.	Chemical requirements.		Physical	
				Phos.	Sulphur.	Tensile strength.	Elastic limit.
Long Island R. R. Co. ....	10-1-97	Bar iron.	None.	None.	None.	47,000 to 49,000 lbs.	None.
The Delaware, Susquehanna & Schuylkill R. R. Co. ....	11-30-97	{ Single refined bar iron. }	"	"	"	None.	"
ditto.	"	{ Double refined bar iron. }	"	"	"	"	"
ditto.	no date	Axle iron.	"	"	"	50,000 lbs.	"
ditto.	8-25-96	{ Triple refined iron for stay-bolts. }	"	"	"	50,000 lbs.	"
Phila. & Reading Ry. Co. ....	4-1-95	Merchant bar iron.	{ The stock from which the iron is rolled should be so piled that the fracture will be uniformly good, regardless of the direction in which the bar is bent. }	"	"	48,000 lbs.	"
Penna RR. Co. ....	3-30-98	Merchant bar iron.	{ It must have originally been made by the puddling process and as furnished may consist either of new muck bar iron or a mixture of muck bar and scrap, but it must be free from admixture of steel scrap. }	"	"	{ 46,000 lbs. min. 53,000 lbs. max. }	"
United States Government, Naval Supply Dept. ....	no date	{ American refined iron. }	None.	.10	.04	{ Not less than 51,000 lbs. }	{ Between 26,000 and 30,000 lbs. }
Northern Pacific Ry. Co. ....	11-1-98	Bar iron.	"	None.	None.	50,000 lbs.	None.
Southern Ry. Co. ....	12-1-95	Bar iron.	"	"	"	{ Flats 1 1/2 in. thick or less, 47,000 lbs.; other sections and for rounds, 49,000 lbs. }	"
Balto. & Ohio RR. Co. ....	6-1-98	Bar iron.	"	"	"	{ Not less than 48,000 lbs. }	25,000 lbs.
			{ Bars 1/2 in. thick or less min. of 47,000 lbs. }				24,000 lbs.
Chicago & Northwestern Ry. Co.	4-1-98	Wrought iron.	None.	None.	None.	{ Round sections, 50,000 lbs. Rectangular sections, 48,000 lbs. }	None.
Great Northern Ry. Co. ....	10-1-92	Merchant bar iron.	"	"	{ Grade No. 1 Grade No. 2 }	{ 50,000 lbs. 47,000 lbs. }	"
Baldwin Loco. Works. ....	1-1-93	Bar iron.	To be made from all muck bar; no scrap to be used.	"	None.	48,000 lbs.	"
ditto.	6-15-97	Double worked muck bar iron.	{ The puddle ball should be freed from as much slag as possible by hammering or squeezing into a bloom. This bloom may be rolled into bars without re-heating, but these bars must be allowed to cool, then cut and piled at least five high, heated, rolled to size and sheared to length. }	Not over .25.	Not over .02.	None.	"
Lehigh Valley RR. Co. ....	6-1-94	Merchant bar iron.	None.	None.	None.	{ Not less than 48,000 lbs. }	"
ditto.	6-1-94	Double refined iron.	"	"	"	ditto	"
Chesapeake & Ohio Ry. Co. ....	no date	Merchant bar iron.	"	"	"	50,000 lbs.	"
Chicago, Milwaukee & St. Paul Ry. ....	3-1-90	{ Staybolt iron. Bar iron. }	"	"	"	50,000 lbs. 48,000 lbs.	"
Illinois Central Ry. Co. ....	no date	"	"	"	"	48,000 lbs.	"
Central RR. Co. of New Jersey ..	"	"	"	"	"	{ Not less than 48,000 lbs. }	"
Norfolk & Western RR. Co. ....	12-1-92	Staybolt iron.	"	"	"	48,000 lbs.	"
ditto.	"	Merchant bar iron.	"	"	"	{ Not less than 48,000 lbs. }	"

# SYNOPSIS OF SPECIFICATIONS FOR WROUGHT IRON.

COMPILED FOR COMMITTEE NO. 1.—AMERICAN SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Physical Properties.			Nicking test.	Cold bending test.	Hot bending test.
Size limit.	Elong. Per cent.	Red. of area. Per cent.			
None.	15 in 8 in.; 18 in 8 in.	None.	Iron to be fibrous, and free from crystallization.	None.	None.
"	15 in 8 in.	"	{ Bars not exceeding 1¼ in. nicked and bent over an anvil, must show a fracture uniformly fibrous. Larger sizes not more than 20% crystalline.	{ D = 2T, without showing cracks or flaws.	D. 1T.
"	23 in 8 in.	"	{ Bars not exceeding 1½ in. nicked and bent must show a fracture uniformly fibrous. Larger sizes not more than 15% crystalline.	{ 180° flat upon itself without showing cracks or flaws.	Same as cold bending test.
"	23 in 10 in.	40	{ Test piece after being broken in test machine when nicked and bent must show a fibrous fracture.	None.	None.
"	23 in 8 in.	48	{ Bars ¾ or 1 in. diam. when nicked and bent must show a uniformly fine fibrous fracture.	{ The bar must stand cold bending double both ways without showing fracture or flaws.	"
"	20 in 2 in.	None.	{ Test piece after being broken in test machine when nicked and bent the fracture should be fibrous and not crystalline or short.	None.	"
"	{ Round, 1¼ in. and over 20% in 8 in. " less than 1¼ in. 16% in 8 in. Flats pulled as rolled 20% in 8 in. Flats reduced 16% in 8 in.	.....	{ When nicked slightly on one side and broken by a succession of light blows it must show a generally fibrous structure not more than 25% crystalline, free from steel.	"	"
a 26.00 and } 000 lbs.	26 in 8 in.	Not less than 54.	{ A bar nicked about 20%, and bent back through an angle of 180°, must show a long, clean silky fibre, free from slag or dirt or any coarse crystalline spots. A few fine spots may be tolerated, but must not exceed 10% of the area of the bar.	{ A bar not more than 1 in. in thickness must bend 180° flat upon itself without cracks or flaws.	{ A bar not over 1 in. thickness to a yellow heat and quenched between 78 and 82° F. must bend upon itself; must work and weld in any manner without signs of shortness.
None.	30 in 8 in.	None.	None.	{ Sizes ¾ in. thick or less must bend cold 180° D. 1T. Sizes larger than ¾ in. must bend 180° D. 1½T.	All sizes 180° flat without fracture.
"	{ 15 in 8 in. 18 in 8 in. }	"	Iron must be fibrous and free from crystallization.	None.	None.
000 lbs. 000 lbs.	18 in 8 in. 15 in 8 in.	"	Fibrous fracture.	"	"
.....	22 in 8 in. 26 in 8 in.	"	"	"	"
None.	25 in 8 in.	"	"	{ Bend cold, 180° D. 1T., without showing fracture.	Same as cold bend.
"	30 in 8 in.	"	"	{ Bars 1¼ in. thick or under to bend 180° D. 1T. Bars above 1¼ in. thick to bend 130° without sign fracture.	{ All iron must be free from red shortness.
"	18 to 22 in 8 in. 15 in 8 in.	"	"	None.	ditto.
"	15 in 2 in.	"	"	180° D. 2T.	None.
"	None.	"	"	"	"
"	Not less than 15 in 4 in.	"	{ Iron will be rejected if it shows a granular fracture covering 50% or more of the surface.	.....	Iron must be free from red shortness.
"	Not less than 20 in 4 in.	"	Fibrous fracture.	180° down flat without flaws.	"
"	22 in 2 in.	"	None.	None.	None.
"	28 in 5 in.	"	Fracture must be wholly fibrous.	"	Iron must be free from red shortness.
"	32 in 5 in.	"	Fracture must be fibrous.	"	"
"	18 in 6 in.	"	"	"	"
"	20 in 2 in.	"	"	180° D. 1T.	"
"	20 in 8 in.	"	Fibrous fracture free from crystallization.	{ Iron 1 in. thick and under 18° D. T. " over 1 in. thick 120° without flaw }	"
"	30 in 2 in.	"	Fracture must be uniformly fibrous.	{ It must stand screw cutting 12 threads per inch screwed into a boiler plate allowed to project ¼ in. through plate. These ends must rivet over to full head without cracking or splitting.	"
"	Not less than 15 in 2 in.	.....	{ Iron will not be accepted if it shows a bad or granular fracture covering more than 50% of the fractured surface.	None.	None.]

## SYNOPSIS OF SPECIFICATIONS FOR WROUGHT IRON.

COMPILED FOR COMMITTEE NO. 1.—AMERICAN SECTION, INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Rod.	Red. of area. Per cent.	Nicking test.	Cold bending test.	Hot bending test.	Drifting test.
18 in x 8 in.	None.	Iron to be fibrous, and free from crystallization.	None.	None.	None.
8 in.	"	{ Bars not exceeding 1½ in. nicked and bent over an anvil, must show a fracture uniformly fibrous. Larger sizes not more than 20% crystalline.	{ D = 2T, without showing cracks or flaws.	D. 1T.	"
8 in.	"	{ Bars not exceeding 1¾ in. nicked and bent must show a fracture uniformly fibrous. Larger sizes not more than 15% crystalline.	{ 180° flat upon itself without showing cracks or flaws.	Same as cold bending test.	"
10 in.	40	{ Test piece after being broken in test machine when nicked and bent must show a fibrous fracture.	None.	None.	"
8 in.	48	{ Bars ¾ or 1 in. diam. when nicked and bent must show a uniformly fine fibrous fracture.	{ The bar must stand cold bending double both ways without showing fracture or flaws.	"	"
2 in.	None.	{ Test piece after being broken in test machine when nicked and bent the fracture should be fibrous and not crystalline or short.	None.	"	"
d over 20% in 8 in. ¼ in. 16% in 8 in. rolled 20% in 8 in. d 16% in 8 in.	.....	{ When nicked slightly on one side and broken by a succession of light blows it must show a generally fibrous structure not more than 25% crystalline, free from steel.	"	"	"
8 in.	Not less than 54.	{ A bar nicked about 20%, and bent back through an angle of 180°, must show a long, clean silky fibre, free from slag or dirt or any coarse crystalline spots. A few fine spots may be tolerated, but must not exceed 10% of the area of the bar.	{ A bar not more than 1 in. in thickness must bend 180° flat upon itself without cracks or flaws.	{ A bar not over 1 in. thickness heated to a yellow heat and quenched in water between 78 and 82° F., must bend 180° flat upon itself; must work and weld in ordinary manner without signs of red shortness.	{ A rod punched and expanded by drift until a round hole is formed, whose diameter is not less than ⅙ of the diameter of the rod.
8 in.	None.	None.	{ Sizes ¾ in. thick or less must bend cold 180° D 1T. Sizes larger than ¾ in. must bend 180° D 1½T.	All sizes 180° flat without fracture.	None.
8 in.	"	Iron must be fibrous and free from crystallization.	None.	None.	"
8 in.	"	Fibrous fracture.	"	"	"
8 in.	"	"	"	"	"
8 in.	"	"	"	"	"
8 in.	"	"	"	"	"
8 in.	"	"	Bend cold, 180° D. 1T., without showing fracture.	Same as cold bend.	"
8 in.	"	"	{ Bars 1½ in. thick or under to bend 180° D. 1T. Bars above 1½ in. thick to bend 130° without sign fracture.	{ All iron must be free from red shortness.	"
2 in.	"	"	None.	ditto.	"
one.	"	"	180° D. 2T.	None.	"
an 15 in x 4 in.	"	{ Iron will be rejected if it shows a granular fracture covering 50% or more of the surface.	.....	Iron must be free from red shortness.	"
an 20 in x 4 in.	"	Fibrous fracture.	180° down flat without flaws.	"	"
n 2 in.	"	None.	None.	None.	"
n 3 in.	"	Fracture must be wholly fibrous.	"	Iron must be free from red shortness.	"
n 5 in.	"	Fracture must be fibrous.	"	"	"
a 5 in.	"	"	"	"	"
n 2 in.	"	"	"	"	"
n 8 in.	"	Fibrous fracture free from crystallization.	180° D. 1T.	"	"
n 2 in.	"	Fracture must be uniformly fibrous.	{ Iron 1 in. thick and under 18° D. T. " over 1 in. thick 120° without flaw }	"	"
an 15 in x 2 in.	.....	{ Iron will not be accepted if it shows a bad or granular fracture covering more than 50% of the fractured surface.	None.	None.]	"

	Test pieces.				Finish.	Inspection.
	For tensile.	For nicking.	For bending.	For drifting.		
{ No standard given. }	None.	None.	None.	None.	{ Iron must be of good workmanship made to the sizes ordered and free from seams or cinder spots; material will be rejected that varies more than $2\frac{1}{2}\%$ from the estimated wt. per running foot. .... }	No statement.
None.	{ $1\frac{1}{4}$ in. sec. area. }	{ $1\frac{1}{4}$ in. sec. area. }	"	"	{ Free from open seams or imperfect welds; crop ends not cut too sparingly. Rolled close to size. }	"
"	{ $1\frac{1}{2}$ in. sec. area. }	{ $1\frac{1}{2}$ in. sec. area. }	"	"	ditto.	"
{ No standard given. }	Use test piece broken in machine.	{ None. }	"	"	ditto.	"
{ $\frac{3}{4}$ or 1 in. round bars tested as rolled. }	{ $\frac{3}{4}$ or 1 in. round bars. }	{ $\frac{3}{4}$ or 1 in. round bars. }	"	"	ditto.	"
{ No standard given. }	Use test piece broken in machine.	None.	"	"	{ Iron must be rolled closely to the size ordered and be free from seams, blisters and flaws. Round iron, 1 in. and below; $1\frac{1}{8}$ in. variation either way allowed. Sizes above 1 in., $1\frac{1}{16}$ in. either way allowed. In flats and squares $\frac{1}{32}$ in. variation either way allowed. }	"
$1\frac{1}{2}$ sq. in.	No size given.	"	"	"	{ It must be smoothly and truly rolled to the ordered dimensions, and must be free from slivers, depressions, cracks and burned edges. }	{ One bar from each 100 will be selected at random and sent to the Testing Dept. at Altoona for testing. }
Not less than $\frac{1}{4}$ -q. in. sectional area.	Bar not more than 1 in. in thickness.	Bar not more than 1 in. in thickness.	Size not given.	"	Free from any admixture of steel cracks, flaws, scabs or cinder spots.	No statement.
{ 1 in. Sectional area. }	None.	{ All sizes so far as practicable. }	None.	"	{ All iron must be free from steel scrap, flaws, blisters or unwelded seams; surface to have a smooth finish. Round iron to conform to M. C. B. standard limit gauges. Flat iron must not vary more than $2\%$ either way. }	If made at the mill the mfr. must prepare samples selected by inspr. and furnish test machines and such assistance as may be necessary.
{ Test piece will be pulled in original section so far as capacity of test machine allows. }			"	"	{ Iron must be of good workmanship made to the sizes ordered, free from seams, blisters or cinder spots, and must not vary more than $2\frac{1}{2}\%$ from estimated wt. }	Mfrs. must furnish free the necessary apparatus and assistance for making tests at the mills.
{ No standard given. }	No standard given.	None.	"	"	{ Iron must be free from seams, blisters and cinder spots and rough or cracked edges. Must not vary more than $2\frac{1}{2}\%$ from estimated wt. }	Material will be inspected and tested on its arrival at destination.
{ 1 in. sectional area. }	Full size sections will be used so far as possible.	"	"	"	{ Iron to be true to size, free from cracks, flaws, and defects of all kinds. }	Mfrs. must furnish test pieces, testing apparatus and assistance necessary to make satisfactory tests.
{ No standard given. }	No standard given.	$1\frac{1}{2}$ in. thick and over.	"	"	Iron to be free from flaws, blisters and other mechanical defects.	No statement.
{ 1 in. sectional area. }	None.	None.	"	"	Iron to be free from seams, flaws, blisters and cinder spots.	At destination.
None.	Full section.	Full section.	"	"	Good finish and free from dirt.	"
{ No standard given. }	No standard given.	No standard given.	"	"	Iron must be close to size; free from seams.	No statement.
"	"	"	"	"	"	"
{ 1 in sectional area. }	"	"	"	"	{ Free from seams and capable of taking a good thread with dies in fair working order. }	"
"	"	"	"	"	{ Iron must be free from flaws, blisters or other mechanical defects; unwelded seams. }	"
{ No standard given. }	"	"	"	"	ditto.	"
"	"	"	"	"	ditto.	"
"	"	"	"	"	Iron must be free from seams, blisters and cinder spots, and must not vary more than $2\frac{1}{2}\%$ from estimated wt. }	"
"	"	"	"	"	{ The iron must be free from longitudinal seams, and be capable of taking a thread with dies in fair working order. }	"
{ No standard given. }	"	"	"	"	Iron must be close to sizes ordered and free from flaws and seams.	"

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5. The four classes of iron when tested as described in paragraph No. 10 shall conform to the following bending tests:

Cold Bend-  
ing Test.

(e). Refined iron shall bend cold  $180^{\circ}$  around a diameter equal to twice the thickness of the specimen tested, without fracture on outside of the bent portion.

(f). Test iron Class A, shall bend cold  $180^{\circ}$  around a diameter equal to the thickness of the tested specimen, without fracture on outside of the bent portion.

(g). Test iron Class B, shall bend cold  $180^{\circ}$  flat on itself without fracture on outside of the bent portion.

(h). Stay-bolt iron, a piece of stay-bolt iron about 24" long shall bend in the middle through  $180^{\circ}$  flat on itself, and then bend in the middle through  $180^{\circ}$  flat on itself in a plane at a right angle to the former direction, without a fracture on outside of the bent portions. Another specimen with a thread cut over the entire length shall stand this double bending without showing deep cracks in the threads.

6. The four classes of iron when tested as described in paragraph No. 11 shall conform to the following hot bending tests:

Hot Bend-  
ing Test.

(i). Refined iron, shall bend sharply to a right angle, without showing cracks or flaws.

(j). Test iron Class A, shall bend through  $180^{\circ}$  flat on itself, without showing cracks or flaws.

(k). Test iron Class B, shall bend through  $180^{\circ}$  flat on itself, without showing cracks or flaws. A similar specimen heated to a yellow heat and suddenly quenched in water between  $80^{\circ}$  and  $90^{\circ}$  F. shall bend, without hammering on the bend,  $180^{\circ}$  flat on itself without showing cracks or flaws. A similar specimen heated to a bright red heat shall be split at the end and each part bent back through an angle of  $180^{\circ}$ . It will also be punched and expanded by drifts until a round hole is formed whose diameter is not less than nine-tenths of the diameter of the rod or width of the bar. Any extension of the original split or indications of fracture, cracks, or flaws developed by the above tests will be

sufficient cause for the rejection of the lot represented by that rod or bar.

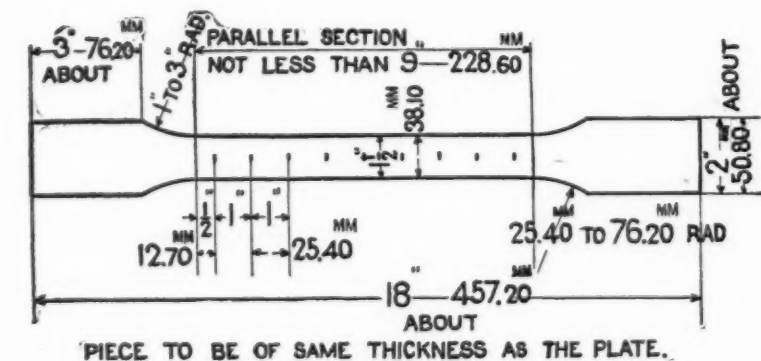
(1). Stay-bolt iron, shall bend through  $180^\circ$  flat on itself, without showing cracks or flaws. A similar specimen heated to a yellow heat and suddenly quenched in water between  $80^\circ$  and  $90^\circ$  F. shall bend, without hammering on the bend,  $180^\circ$  flat on itself without showing cracks or flaws.

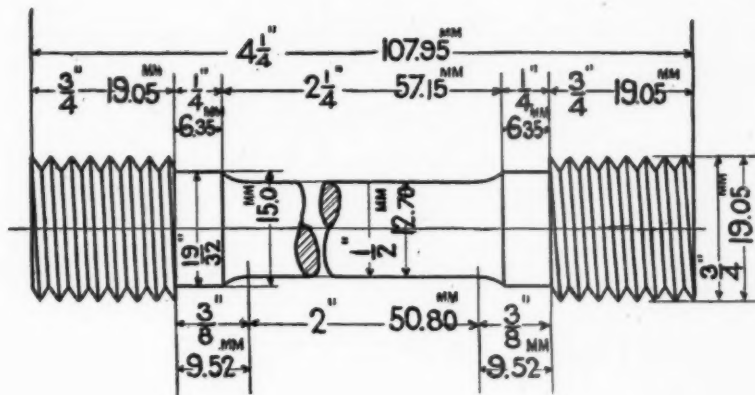
7. Stay-bolt iron shall permit of the cutting of a clean sharp thread and be rolled true to gauges desired, so as not to jam in the threading dies.

Threading  
Test.

#### TEST PIECES AND METHODS OF TESTING.

8. Whenever possible iron shall be tested in full size as rolled, to determine the physical qualities specified in paragraphs Nos. 2 and 3, the elongation being measured on an eight inch (8") gauged length. In flats and shapes too large to test as rolled, the standard test specimen one and one-half inches ( $1\frac{1}{2}$ ") wide and eight inch (8") gauged length. In large rounds the standard test specimen of two inch (2") gauged length shall be used; the center of this specimen shall be half way between the center and outside of the round. Sketches of these two standard test specimens are as follows :





9. Nicking tests shall be made on specimens cut from the iron as rolled. The specimen shall be slightly and evenly nicked on one side and bent back at this point through an angle of 180° by a succession of light blows. Tested iron Class B, and stay-bolt iron may be nicked approximately 20 per cent. of its thickness.

Nicking Tests.

10. Cold bending tests shall be made on specimens cut from the bar as rolled. The specimen shall be bent through an angle of 180° by pressure or by a succession of light blows.

Cold Bending Tests.

11. Hot bending tests shall be made on specimens cut from the bar as rolled. The specimens, heated to a bright red heat, shall be bent through an angle of 180° by pressure or by a succession of light blows and without hammering directly on the bend.

Hot Bending Tests.

If desired a similar bar of any of the four classes of iron shall be worked and welded in the ordinary manner without showing signs of red shortness.

12. The yield point specified in paragraph No. 2 shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

Yield Point.

#### FINISH.

13. All wrought iron must be practically straight, smooth, free from cinder spots or injurious flaws, buckles, blisters or cracks.

As the thickness of bars approaches the maximum that the rolls will produce the same perfection of finish will not be required as in thinner ones.

In flat and square bars one thirty-second of an inch ( $1/32''$ ) variation either way from the size ordered will be allowed.

In round iron one one-hundredth of an inch ( $1/100''$ ) variation either way from the size ordered will be allowed, except in stay-bolt iron which shall be at least one one-hundredth of an inch ( $1/100''$ ) and not more than twenty-five thousandths of an inch ( $25/1000''$ ) below normal size, to insure freedom from jamming in the threading dies.

#### INSPECTION.

14. The inspector representing the purchaser, shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.